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An interesting new species of *Osteospermum* (Asteraceae–Calenduleae) from the Western Cape Province, South Africa, providing a link to the genus *Chrysanthemoides*

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The new species *Osteospermum potbergense* A.R. Wood & B. Nord. (Asteraceae–Calenduleae) is described from the Potberg, Western Cape Province, South Africa. This procumbent shrublet is distinguished from all closely related species in *Osteospermum* and *Chrysanthemoides* by its coriaceous spathulate or oblanceolate to elliptic-obovate leaves which have a reddish cartilagenous margin. It is provisionally placed in *Osteospermum* L. sect. *Homocarpa* Norl., where it technically belongs according to currently accepted generic taxonomy. However, it also has obvious affinities to the small genus *Chrysanthemoides* Medik. and forms a sterile hybrid with a race of *C. monilifera*. The generic delimitation in South African Calenduleae needs further examination. Adaptations to dispersal by ants and birds in *Osteospermum* and *Chrysanthemoides* are briefly discussed, with special reference to cypsela morphology in *O.* sect. *Homocarpa*, *Polygalina*, and *Coriacae*. Two species, *O. triquetrum* L. f. and *O. subulatum* DC., are transferred to sect. *Homocarpa*; the former hitherto unassigned to section and the latter previously placed in sect. *Trialata* Norl.

Introduction

The tribe Calenduleae Cass, one of the smallest tribes of the Asteraceae, has a distinct centre in South Africa, where all but one of the currently accepted genera occur as well as the great majority of species (Norlindh 1943, 1960, 1977). Eight genera with about 110 species are usually distinguished (e.g. Nordenstam 1994a), but generic limits and relationships within the tribe are not yet finally resolved (Nordenstam 1994a, 1994b, 1996).

The new species described in this paper provides a link between the genera *Osteospermum* L. and *Chrysanthemoides* Medik. and thus underlines the problems of generic classification. Technically it belongs in *Osteospermum* sect. *Homocarpa*, but it is clearly allied to *Chrysanthemoides monilifera* and apparently also hybridises with a sympatric population of the latter. Pending a revised generic taxonomy based on phylogenetic studies (Nordenstam and Wood in prep.) the new species is provisionally placed in *Osteospermum* sect. *Homocarpa*. The sole difference between the two genera is the presence of a fleshy coloured exocarp on the cypselas of *Chrysanthemoides* (which are usually named 'drupes' in literature), whereas the cypselas of *Osteospermum* are said to be dry and lacking a fleshy outer layer. This distinction is insufficient for generic separation as will be demonstrated and further discussed below.

Taxonomic Treatment

Osteospermum potbergense A. R. Wood & B. Nord., sp. nov. TYPE: South Africa, Western Cape, 3420 (-AD) Malgas: E of Bredasdorp, De Hoop Nature Reserve, just S of Potberg Education Centre, 34°23'S, 20°32'E, 15 Sep. 2002, *A.R. Wood 459* (S holo.! BOL, K, MO, NBG, PRE iso.!). — Figures 1–4.

Frutex humilis prostratus vel procumbens 0.1–0.2m altus glaber sed partibus juvenilibus araneoso-tomentosis mox glabrescentibus saepe multicaulis e caudice lignoso, caules sparse ramosis, rami teretes sulcati. Folia alterna erecto-patentia petiolata, petioli 0.5–1.5cm longi, lamina spathulata vel oblanceolata ad elliptico-obovata integra 1.5–3.5cm longa 1–2cm lata coriacea nervo medio conspicuo apice acuta vel obtuse mucronulata basin versus in petiolum cuneatim angustata, margine 1–4-dentato-serrulato vel interdum subintegro cartilagineo parum revoluto, folia novella araneoso-tomentosa mox glabrescentia. Capitula heterogama radiata solitaria in apicibus ramulorum, pedunculis 1.5–2.5cm longis bracteatis laxe albo-tomentosis, bracteis 5–7 lineari-lanceolatis vel subulatis. Involucrum late cupuliforme-campanulatum; squamae numerosae imbricatae (c. triseriatae) oblongo-lanceolatae usque ad 1cm longae et 3mm latae (exterioribus parum minoribus) acuminatae costatae laxe albo-tomentosae. Receptaculum planum vel leviter convexum laeve minute

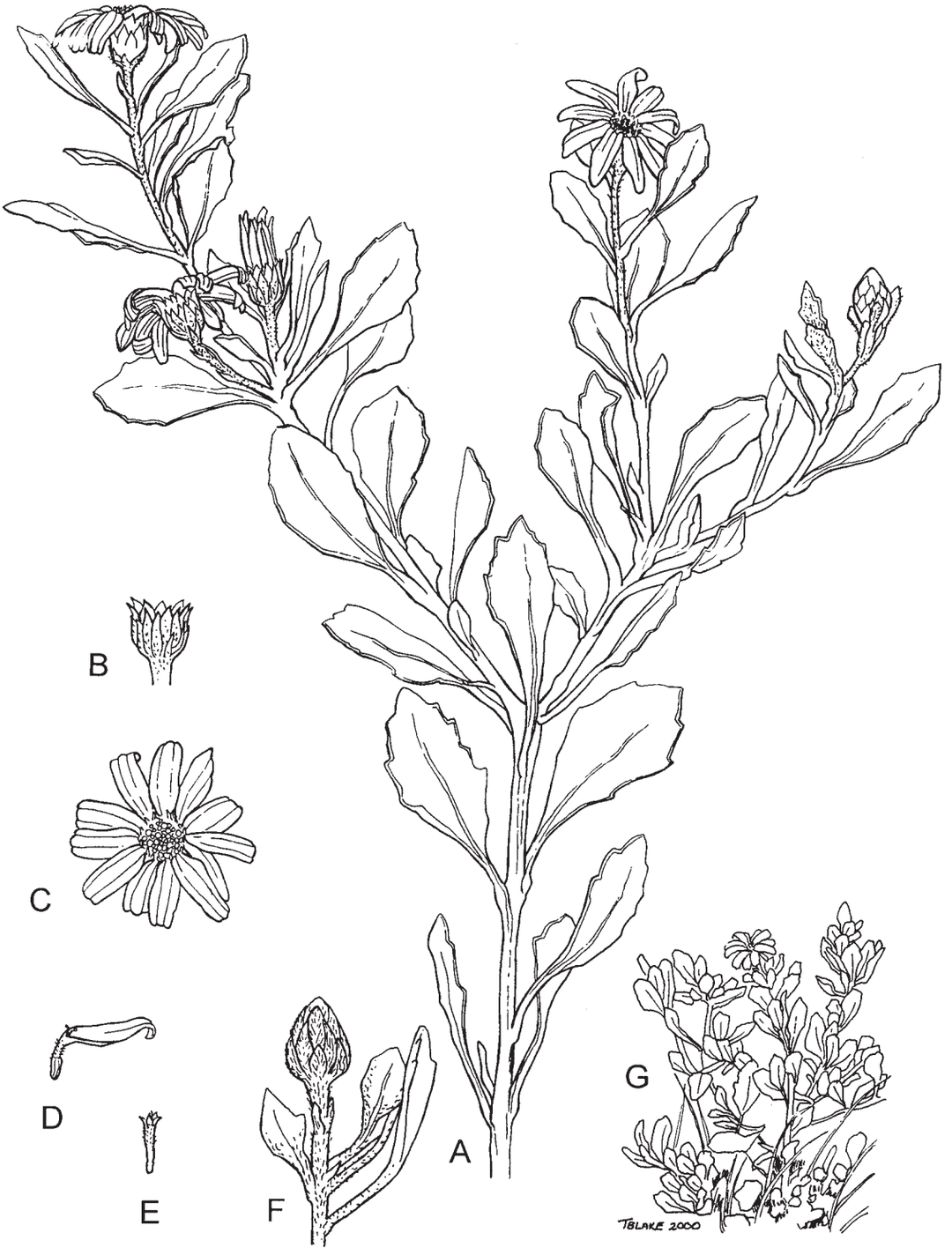

Figure 1: *Osteospermum potbergense.* (**A**) Portion of plant, x1. (**B**) Involucre, x2. (**C**) Flowerhead, x2. (**D**) Ray floret, x2. (**E**) Disc floret, x2. (**F**) Branch tip with flowerhead in bud, x2. (**G**) Habit. Del. T. Blake

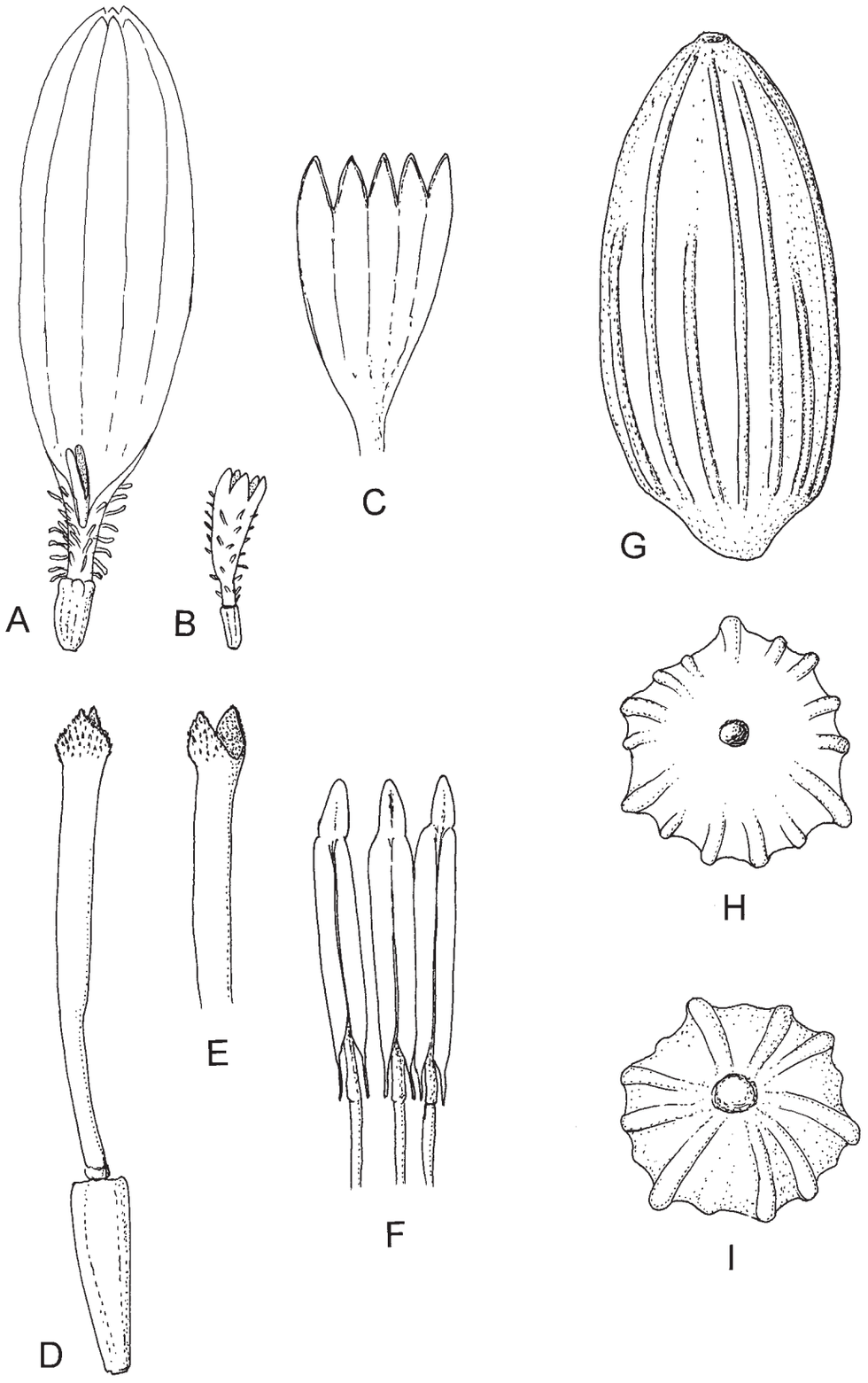

Figure 2: *Osteospermum potbergense.* (**A**) Ray floret, x6. (**B**) Disc floret, x6. (**C**) Disc floret corolla laid out, x12. (**D–E**) Style of disc floret, x25. (**F**) Anthers, x25. (**G**) Cypsela (epidermis removed), x15. (**H**) Cypsela, basal view, x15. (**I**) Cypsela, top view, x15. Del. B. Nordenstam (G–I based on a sketch by AR Wood)

Figure 3: *Osteospermum potbergense* habit in the type locality. Photo AR Wood

alveolatum. Flosculi radii 12–13 feminei fertiles, tubo brevi sparse villoso, limbo anguste elliptico-oblongo c. 1.5cm longo flavo subtus rubescens. Cypsela oblongo-ellipsoidea laevis glabra extus carnosa lactea leviter costata calva. Flosculi disci numerosi pseudohermaphroditi ♀-steriles, corolla tubulosa sensim ampliata 5-lobata, lobis anguste ovati-triangularibus. Antherae basi caudatae. Stylus apice breviter bilobatus lobi estigmatosi deltoidei acuti minute papillosi. Ovarium sterile subcompressum glabrum 2-venosum.

Prostrate or procumbent shrublets 0.1–0.2m high, sparsely branched, but usually many-stemmed and often resprouting (coppicing) from the woody subterranean caudex (especially after fires), shortly white-araneose-tomentose on young vegetative parts but soon glabrescent. Stems and branches somewhat striate-ribbed. *Leaves* alternate, erecto-patent, petiolate, petiole 0.5–1.5cm long; lamina spathulate or oblanceolate to elliptic-obovate and tapering to the petiole, coriaceous, bright green, midrib prominent, glabrous (except when young), margins markedly cartilaginous and slightly revolute, somewhat reddish, sparsely coarsely dentate in the distal half or subentire (1–4 obtuse-apiculate teeth on each side), apex subobtuse to acute and mucronulate, 2–3.5cm long, 1–2cm wide. *Capitula* heterogamous, radiate, solitary on short bracteate loosely white-tomentose peduncles barely overtopping the leaves; peduncles 1.5–3cm long, bracts 4–7, linear-lanceolate, c. 5mm long, acuminate. *Involucre* campanulate, c. 1–1.2cm x 0.7–0.8cm, involucral bracts c. 22–30, imbricate in c. 3 series, white-tomentose especially in the distal half, oblong-lanceolate, acuminate, 7–10mm x 2–3mm, outer somewhat shorter (6mm x 1.5–2mm), with narrow membranous-scarious fimbriate margins, receptacle flat or somewhat convex, naked, minutely alveolate. *Ray florets* female, (12–)13, pappus absent; tube sparsely to rather densely villous with biseriate multicellular hairs, 1–2mm long; limb narrowly elliptic-oblong to oblanceolate, 12–18mm x 3.5–5mm, 4-veined, apically 3(–4)-fid, yellow with red-tinged reverse; *style branches* linear, obtuse, with marginal stigmatic areas; ovary somewhat compressed-triquetrous with flat or slightly convex abaxial side and ridged abaxial side, smooth, glabrous; *cypsela* oblong-ellipsoid, terete or slightly triquetrous, 6–7mm long, 3–3.5mm wide, basally somewhat constricted to a short truncate carpopodium, with a thin transparent deciduous epidermis over a fleshy whitish layer, soon drying out and becoming transversely wrinkled; seed surface becoming dry, black or brownish, longitudinally ridged with 3–5 low complete ribs and a few incomplete parallel ribs in between. *Disc florets* numerous, pappus absent; *corolla* tubular below, widening upwards to a narrowly campanulate limb, proximally villous up to the lobes with biseriate hairs, 4.5–5.5mm long; lobes 5, narrowly ovate-triangular, 1–1.2mm long, with marginal veins joining at sinuses and continuing down the corolla; *anthers* 2.5mm long incl. appendage, caudate with tails equalling the filament collar in length; apical appendage narrowly ovate-triangular, acute, midlined; *style* terete on a short stylopodium, apically shortly bilobed with deltoid short-acuminate lobes with acute papillae outside; *ovary* glabrous, smooth, somewhat compressed, 2-veined.

Flowering period: July–December.

Etymology: Named for the mountain to which this new species is apparently restricted.

Distribution and Habitat

Osteospermum potbergense grows on the lower slopes of the Potberg, mainly on the South side, and in the valley between the mountain and the coastal limestone hills (Figure 4). It is fairly common in this restricted area, where it grows in short or sparse fynbos vegetation on gravel and sand derived from Table Mountain Sandstone (TMS), never on limestone. The species has a subterranean woody caudex which resprouts quickly after periodic fires. *O. potbergense* does not produce adventitious roots where the decumbent stems touch ground.

Specimens Examined (in addition to the type)

— 3420 (–BC) Malgas: SOUTH AFRICA, Western Cape Province: Bredasdorp Div., middle S slope of the Potberg, 12 Oct. 1940, *Pillans 9331* (BOL, PRE); Potteberg, on recently burnt ground, 12 Nov. 1954, *B. Maguire 2594* (NBG,

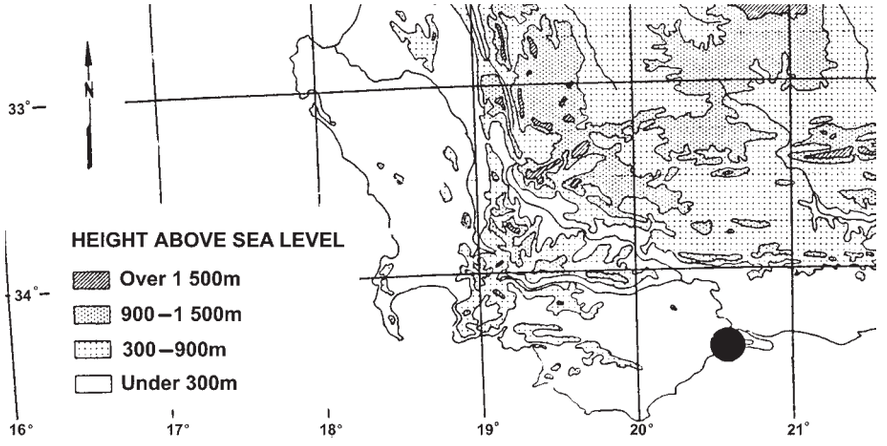

Figure 4: Known distribution of *Osteospermum potbergense*

2 sheets); De Hoop–Potberg Nature Reserve, Potberg, rocky lower slopes of mountain at entrance to Boskloof, rocky TMS outcrops, 200m, 7 Sep. 1978, *Burgers 1108* (NBG ex STE); Potberg, along Infanta road midway between Poortsrivier and Albertsdale, fynbos on dry N slopes, TMS gravels, 75m, 14 Oct. 1978, *Burgers 1337* (NBG, PRE); S side of Potberg, near site of Cape Vultures, dense fynbos on sandstone, slight slope, S aspect, 11 Oct. 1981, *Mauve & Hugo 156* (NBG, PRE); c. 0.5km SW Potberg Education Centre, 24 Sep. 1983, *3rd Exc. Univ. STE 10* (NBG); c. 500m S of Potberg Education Centre, De Hoop Nature Reserve, 34°23'S, 20°32'E, July 1995, *A.R. Wood 401* (S); same locality 9 Dec. 1997, *A.R. Wood 403* (S); same locality 23 Dec. 1999, *A.R. Wood 425* (S); same locality: seed and spirit collection, 22 Nov. 2000, *A.R. Wood 449* (S); near base of gorge with vulture colony c. 2km E of Potberg Education Centre, De Hoop Nature Reserve, 34°22'S, 20°33'E, 11 Oct. 1999, *A.R. Wood 418* (S).

Discussion

Although growing in a very restricted area, *O. potbergense* has been collected several times, first in 1940 by NS Pillans. It has previously been misidentified as *Chrysanthemoides monilifera* even by specialists such as T Norlindh and recently RC Griffoen, usually as ssp. *pisifera* (L.) Norl. Herbarium specimens of the new species may look very similar to forms of *C. monilifera*, but in nature it is strikingly dissimilar. It has a very different habit being a prostrate shrublet less that 0.2m high, and the flowerheads are borne singly on short peduncles. Furthermore, the distinct leaf margins are cartilaginous and somewhat revolute, and the cypsela is not a fleshy 'drupe', but only has a very thin fleshy outer layer (like other species of sect. *Homocarpa*) without striking colours (Figure 5). This subtle character is only observable on fresh material. This new species is not adapted to dispersal by birds as are the taxa of *Chrysanthemoides* and possibly also *O. junceum* Berg. of sect. *Coriacea* (see discussion below), since unlike these our species has the cypselas enclosed within the involucre, this latter eventually reflexes towards the ground allowing passive release of the cypselas once they are mature. Possibly the fruits are ant-dispersed, which should be investigated. The capitula are similar in size and shape to those of *C. monilifera* ssp. *pisifera* and cypselas were until recently uncollected, which may have contributed to the confusion in the past of these taxa. The coriaceous spathulate or oblanceolate to elliptic-obovate leaves with a cartilaginous margin distinguish *O. potbergense* from all other species in *Osteospermum* sect. *Homocarpa*.

Mature seeds of *O. potbergense* are not easily found, since the flowerheads are heavily predated, probably by mice, as is the case with the fleshy cypselas falling to the ground in mature stands of *Chrysanthemoides monilifera* (Scott 1996).

Apparently *O. potbergense* is endemic to the Potberg, incidentally like another species of sect. *Homocarpa*, viz. *O. elsieae* Norl. The latter is also confined to TMS derived soils on the lower slopes of the mountain amongst boulders where it is protected somewhat from fires and competition from other plants (B.N. obs. 20 Sep. 1962, *Nordenstam 1536* in S; A.R.W. obs. 11 Oct. 1999, *A.R. Wood 417* in S), and has a similar cypsela with a thin fleshy layer and a whitish appearance.

Osteospermum potbergense and a race of *C. monilifera* (the taxonomic status of which remains to be determined) grow together at the type locality of the former, and some plants are believed to be hybrids. They have been examined in the field and some specimens have been collected (*A.R. Wood 402*, July 1995 in S; *A.R. Wood 404*, 8 Dec. 1997 in S). The hybrid plants (about five specimens noted) are intermediate in growth habit, being ascending shrubs about 0.5–0.7m high with lax branches, and intermediate in leaf shape and hairiness. Viable cypselas are apparently not formed. The hybrids also appear to be intermediate in susceptibility to a rust fungus, *Endophyllum osteospermi* (Doidge) A.R. Wood which heavily infects *C. monilifera* in this area (Wood 2002) and causes large witches' brooms on its host plants, whereas *O. potbergense* is seldom infected.

Osteospermum sect. *Homocarpa* is defined as having

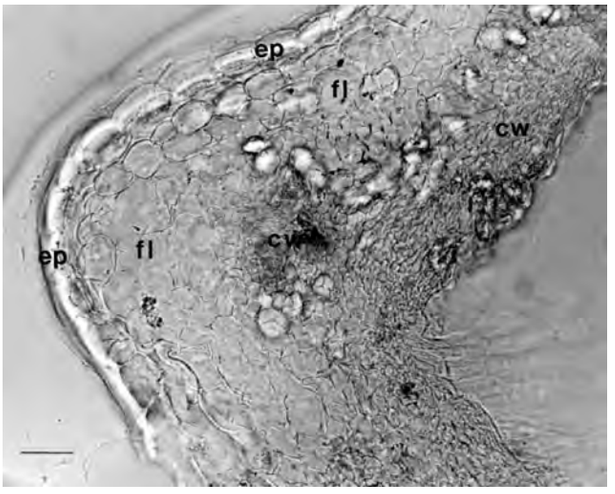

Figure 5: Transverse section through one of the longitudinal ridges on the cypsela of *Osteospermum potbergense* showing epidermis (ep), fleshy layer of thin walled cells (fl), and cypsela wall of sclerified cells (cw). Scale bar = 30µm

homomorphous, terete, smooth or slightly striate cypselas (Norlindh 1943). *Osteospermum potbergense* differs in having distinct ridges along the entire length of the cypsela, rather than just near the base as in species such as *O. ciliatum* Berg. However in other characteristics, such as the separate epidermis of the cypsela, and habit, this species is most closely affiliated with species in sect. *Homocarpa*. Two other species, *O. triquetrum* L. f. and *O. subulatum* DC., have also been found to have similar fleshy and ridged cypselas (pers. obs.). *Osteospermum triquetrum* was unassigned to a section as no cypselas had been collected previously, and *O. subulatum* was placed in sect. *Trialata* as only immature cypselas had been observed and the ridges were assumed to be wing initials (Norlindh 1943). The true affinity of these two species therefore appears to be with *O. potbergense* in sect. *Homocarpa* and they are transferred accordingly to this section of *Osteospermum*.

Notes on cypsela morphology in the Osteospermum–Chrysanthemoides *complex*

Chrysanthemoides is distinguished from *Osteospermum* on the single character of possessing cypselas usually described as 'drupes', i.e. having an outer fleshy and coloured layer, whereas those of *Osteospermum* (and all other genera of the tribe, and the family) have been reported to have dry cypselas. The *Chrysanthemoides* fruits are obvious adaptations to dispersal by birds (ornithochory). Birds, monkeys and people have been recorded as feeding on the fruit in South Africa (Palmer and Pitman 1972, Pooley 1993). *Chrysanthemoides* fruits are important components in the diet of the Cape Bulbul (*Pycnonotus capensis* (L.)) (Keith *et al.* 1992) and the Speckled and White-backed Mousebirds (*Colius striatus* Gmelin and *C. colius* (L.)) (Rowan 1967). Other birds recorded as eating the fruit in South Africa are the African Green Pigeon (*Treron calva* Temminck), Fiscal Flycatcher (*Sigelus silens* (Shaw)), Redwinged Starling (*Onychognathus morio* (L.)), Glossy Starling (*Lamprotornis nitens* (L.)), Crested Barbet (*Trachyphonus vaillantii* Ranzani), Blackcollared Barbet (*Lybius torquatus* (Dumont)), and Collared Sunbird (*Anthreptus collaris* (Vieillot)) (Joffe 2001). In Australia, where *C. monilifera* is an invasive weed, cattle, foxes, rabbits and emus have been recorded as dispersers in addition to frugivorous birds (Meek 1998, Weiss 1986). In St. Helena, where *Chrysanthemoides* is likewise an early introduction, dispersal by the Indian Myna (*Acridotheres tristis* (L.)) has been reported (Ashmole and Ashmole 2000).

In *Osteospermum* both ant and wind dispersed cypselas are known to occur, the former mode of dispersal mainly in the fynbos and the latter in the karoo (Bond and Slingsby 1983). It has been suggested that ant-dispersal (myrmecochory) in the fynbos is an adaptation to avoid predation of the seed by rodents (Bond and Slingsby 1983). Bird dispersal in *Chrysanthemoides* may achieve the same benefit, as cypselas dropping to the ground in mature stands are readily eaten by mice preventing recruitment (Scott 1996).

The fruits of *Chrysanthemoides* have a distinct fleshy layer, which is red, brown or purplish to black. However, several species of *Osteospermum* sections *Homocarpa*, *Polygalina* and *Coriacea* have a more or less well developed but thin fleshy layer, sometimes also with a striking colour. This is only observable on fresh material, which explains why this character has been overlooked by earlier workers including the monographer of the tribe, T. Norlindh. The fruits of *O. junceum* (the sole member of sect. *Coriacea*) have a fleshy exocarp with a striking purple or almost black colour (Figure 6), and in some members of sect. *Homocarpa* and *Polygalina* there is a thin brown or whitish and opaque fleshy layer, most notably in *O. asperulum* (DC.) Norl., *O. corymbosum* L. (Figure 6) and *O. triquetrum*. Only a very thin fleshy layer occurs in *O. ciliatum*, *O. elsieae*, *O. pyrifolium* Norl. and *O. subulatum* (pers. obs.). These observations were made opportunistically as and when plant material was found in the field with mature cypselas.

The fruits of our new species can be described as somewhat intermediate between those prevalent in *Osteospermum* sect. *Homocarpa* and in *Chrysanthemoides*. As is usual in sect. *Homocarpa*, the fruit of *O. potbergense* has an epidermis made up of a single cell layer which loosens with maturity. This skin is opaque and whitish. Below this there is a layer of 4–6 series of thin-walled cells which is a creamy or light purple on maturity. Under this layer is the seed coat, which is ornamented, having usually three equidistant main ridges along the whole seed and with smaller parallel twin ridges in between, and finally single small and incomplete ridges between the main and secondary (twin) ridges. The ridges have vascular bundles which can be seen in cross section (Figure 5). As the mature fruit dries, the seed coat becomes black or brownish with the ridges becoming visible and prominent, and the epidermis is shed.

Other characters typical of ornithochory are also present in *Chrysanthemoides*, such as stiff and erect branches (adaptations for perching), more or less bare peduncles, and

Figure 6: Capitulum of *Osteospermum junceum* showing dark purple colour of mature cypselas (left, x1), and a single mature cypsela of *O. corymbosum* showing brown colour and elaiosome (right, x3)

erect capitula with fruits exposed. *Osteospermum junceum* also has these characteristics, and may therefore be bird dispersed. However this species has only a thin fleshy layer around the cypsela and may therefore rather be ant dispersed. *Osteospermum junceum* has a wide distribution in the Cape Province mountains from Stellenbosch to Grahamstown, a distribution as extensive as any of the subspecies of *C. monilifera* (Norlindh 1943). A wide distribution is a potential characteristic of bird dispersed plants (Goldblatt 1997). Field observations are required to determine to which dispersal guild *O. junceum* belongs.

These observations blurr the traditional distinction between *Chrysanthemoides* and *Osteopermum* and suggest a revision of the generic taxonomy. Whether *Chrysanthemoides* should be sunk in *Osteospermum* or form a separate genus together with some elements of present-day *Osteospermum*, is too early to tell. At this stage of our investigations we adhere to the traditional generic classification in the tribe and place our new species in *Osteospermum*.

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